AGRICULTURAL PRODUCTIVITY

Agricultural productivity is a synonym for agricultural efficiency. The *yield per unit area* is known as agricultural productivity. Agricultural productivity is generally the result of the physical, socio-economic, and cultural factors. It is also affected by the managerial skill of the farmer. Agricultural productivity, however, is a dynamic concept which changes in space and time.

Agricultural productivity of a region is closely influenced by a number of physical (physiography, terrain, climate, soils, and water), socioeconomic, institutional, and organisational factors. Agricultural productivity also depends on the managerial skill of the farmer, his attitude, and aspirations for the better standard of living.

The delineation of agricultural productivity has great significance in the planning of agriculture of a region. The main advantages are:

(i) It helps in ascertaining the relative productivity of the component areal units of a region.
(ii) It helps in identifying the weaker areas which are lagging behind in agricultural productivity.
(iii) The existing patterns of agricultural productivity is a reliable index to assess the agricultural development of the past.
(iv) It provides a sound base for the agricultural development planning.

Agricultural geographers and economists have developed a number of methods for the measurement of agricultural productivity. Some of the important methods used by the geographers are given as under:

1. Output per unit area.
2. Production per unit of farm labour.
3. Agricultural production as grain equivalent (Buck, 1967).
4. Input-output ratio (Khusro, 1964).
5. Ranking Coefficient Method (Kendall, 1939, Stamp, 1960).
6. Carrying capacity of land in terms of population (Stamp 1958).
7. Determining a productivity index on the basis of area and yield (Enyedi, 1964, Shafi 1972).
8. Determining an index of productivity with the help of area and production under various crops in the areal units and converting them in a uniform scale.
9. Converting total production in terms of money (Husain, 1976)
10. To assess the net income in Rupees per hectare of the cropped area (Jasbir Singh, 1985).
11. Assessing net income (farm business income) in Rupees per hectare of cropped area or per adult male unit of farm work-force (Tiwari, Roy, and Srivastava, 1997).

Each of the methods and techniques adopted by the agricultural geographers has its own merits and demerits. None of the techniques, however, gives satisfactory results at the national and/or global level. Some of the techniques are cumbersome and time-consuming to apply for the delineation of agricultural productivity regions. The Kendall's technique of ranking coefficient used by many of the leading geographers for the demarcation of agricultural productivity regions has been illustrated below.

Ranking Coefficient Method of Agricultural Productivity

The ranking coefficient method adopted by Kendall is quite simple and easy to apply. In this technique, the component areal units are ranked according to the per hectare yield of crops and

In the arbitrary choice method, the first two or the first three crops in the area are included and the rest of the crops are excluded from the combination. This is an unscientific method as the crops are excluded from the combination without any consideration of their percentage area and their monetary value.

The second method is known as the *statistical method.* This method being based on statistical formula is more scientific and reliable for the objective grouping of crops. In the field of agricultural geography, Weaver (1954) was the first to use statistical technique for the demarcation of crop combination regions of the Middle West (USA).

In his attempt to demarcate the agricultural regions of the Middle West (USA), Weaver based his analysis on acreage statistics. Weaver computed the percentage of total harvested cropland occupied by each crop that held as much as one per cent of the total cultivated land in each of the 1081 counties covered in his research work. He devised a rigorous approach that would provide an objective, constant and precisely repeatable procedure and would yield comparable results for different years and localities. In his work, Weaver calculated deviation of the real percentages of crops (occupying one per cent of the cropped area) for all the possible combinations in the component areal units against a theoretical standard. The theoretical curve for the standard measurement was employed as follows:

Monoculture = 100 per cent of the total harvested crop land in one crop
2-crop combination = 50 per cent in each of the two crops
3-crop combination = 33.3 per cent in each of the three crops
4-crop combination = 25 per cent in each of the four crops
5-crop combination = 20 per cent in each of five crops
10-crop combination = 10 per cent in each of 10 crops

For the determination of the minimum deviation the standard deviation method was used:

$$SD = \sqrt{\frac{\Sigma d^2}{N}}$$

Where 'd' is the difference between the actual crop percentage in a given county (areal unit) and the appropriate percentage in the theoretical curve and 'n' is the number of crops in a given combination.

As Weaver pointed out, the relative, not absolute, value being significant, square roots were not extracted; so the actual formula used was as follows:

$$d = \frac{\Sigma d^2}{n}$$

To illustrate Weaver's technique an illustration can be given from the Gorakhpur district where the percentage share of crops in the total harvested area in a year was as follows: rice—48 per cent, wheat—23 per cent, barley—15 per cent, sugarcane—6 per cent, and pulses—5 per cent.

$$\text{Monoculture} = \frac{(100-48)^2}{1\,\text{crop}} = 2704$$

$$\text{2-crop combination} = \frac{(50-48)^2 + (50-23)^2}{2\,\text{crops}} = 366.5$$

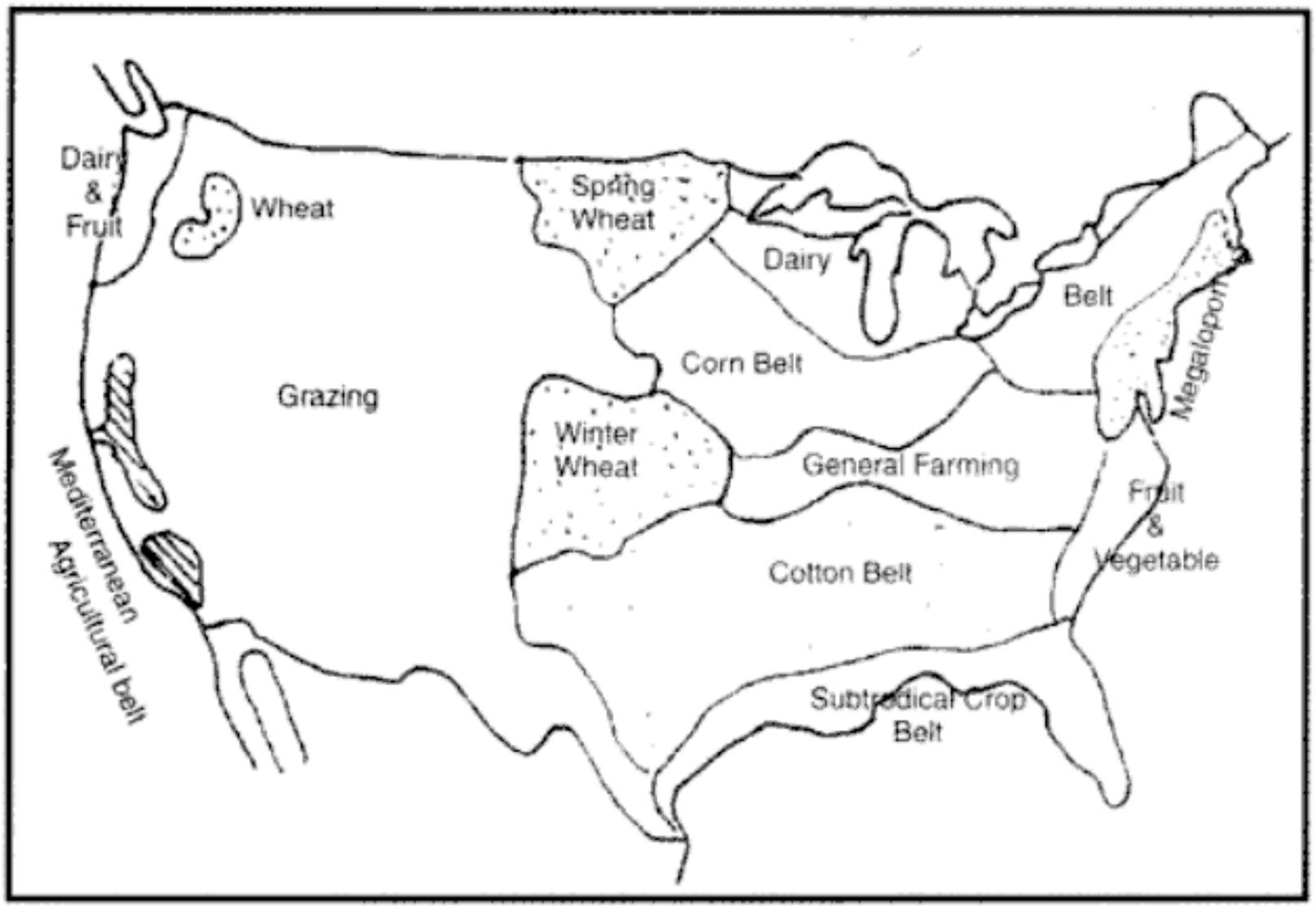

Fig. 10.5 Agricultural Belts of USA (After Baker)

In the multi-element or statistical techniques, the agricultural regions may be demarcated with the help of the following:

(i) Cropping patterns, crop concentration, and crop diversification
(ii) Crop combination
(iii) Regional patterns of agricultural productivity

Some of the studies made with the help of the multi-element techniques gave very reliable agricultural regions. In the developing countries the non-availability of reliable data is a limiting factor in the application of this technique.

(iv) **Quantitative-cum-Qualitative:** The technique in which the physical (geo-climatic factors), socio-economic, cultural, and political factors are taken into consideration for the demarcation of cultural regions is known as the quantitative-cum-qualitative method. The factors which are taken into consideration for the delineation of agricultural regions on the basis of quantitative-cum-qualitative techniques are six physical traits: (i) relief, (ii) climate, (iii) surface and subsoil water, (iv) soil, (v) sub-soil, and (vi) natural vegetation; and six functional traits: (i) rural population, (ii) cultural and religious values, (iii) technological, (iv) farming operations, (v) dependent rural population, and (vi) degree of commercialisation.

The non-availability of reliable data and the quantification of cultural-cum-religious values are the limiting factors in the delineation of agricultural regions with the help of this technique.

Many of the scholars have attempted to delineate the agricultural regions of India. The divisions of India into climatic divisions made by L.D. Stamp (1958), M.S.A. Randhawa (1958), O.H.K. Spate and A.T.A. Learmonth (1960), P. Sengupta and G. Sdasyuk (1967), R.L. Singh (1971) and Jasbir Singh (1975) are important. A brief account of some of the important agricultural regionalisations of India have been given in the following section.

agricultural activities. For the planning of agriculture, the Planning Commission and the National Remote Sensing Agency (NRSA) have divided the country into 15 agro-climatic regions (**Fig. 10.9**). The main objectives of agro-climatic regions are

(i) to optimise agricultural production;
(ii) to increase farm income;
(iii) to generate more rural employment;
(iv) to make a judicious use of the available irrigation water;
(v) to reduce the regional inequalities in the development of agriculture.

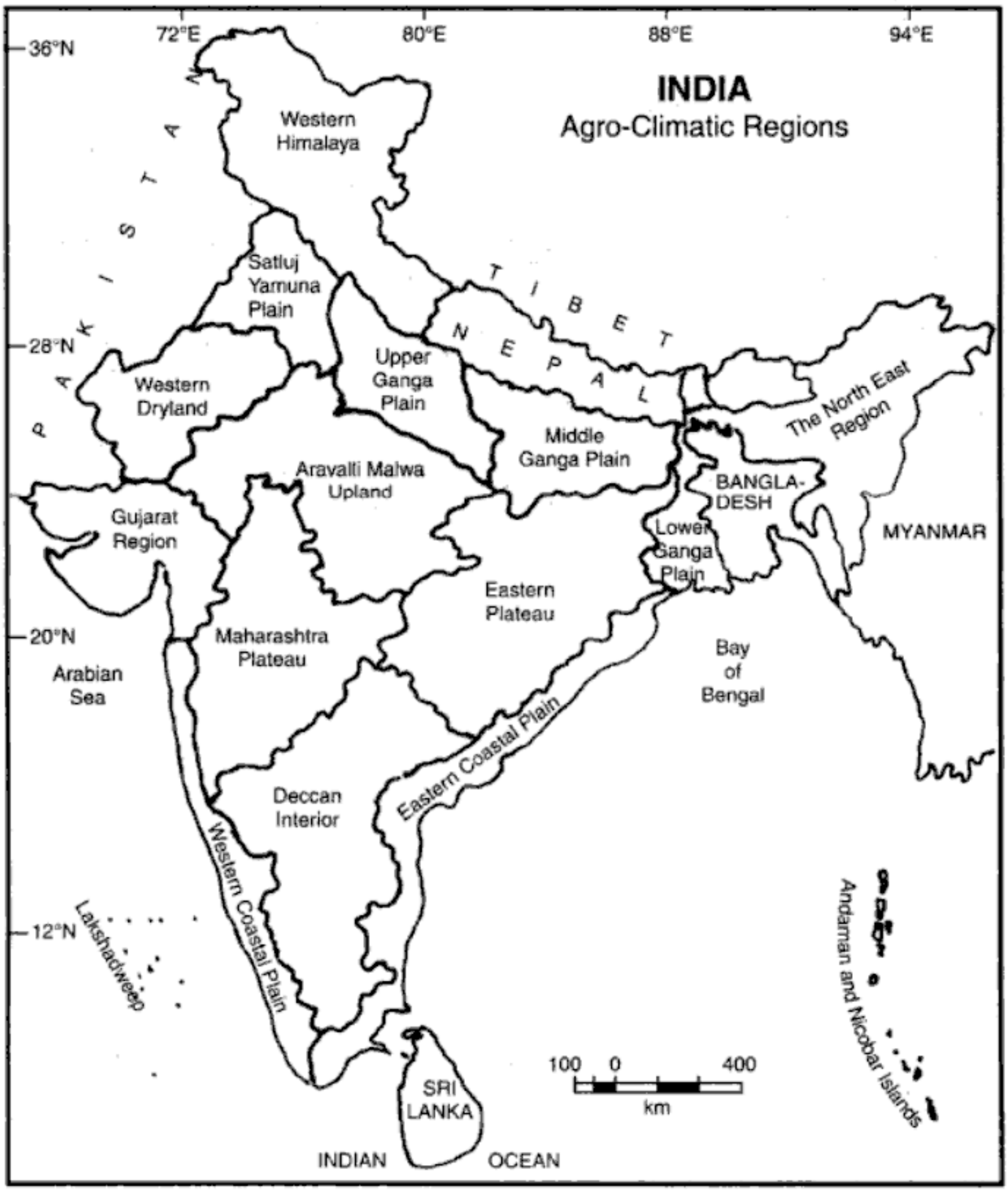

Fig. 10.9 Agro-Climatic Regions

14. The Western Region

This region stretches over Rajasthan west of the Aravalli mountains, and northern Gujarat. The mean July and January temperatures vary between 45°C and 10°C respectively. The mean annual rainfall is less than 25 cm.

Bajra, pulses, and fodder are the main crops. Livestock contributes greatly to the desert ecology. Rain water harvesting horticulture of date-palm, water-melon, and plums deserve more attention.

15. The Islands Region

This region includes Andaman-Nicobar, and Lakshadweep which have marine equatorial climates. At Port Blair, the mean July and January temperatures read 30°C and 25°C, respectively. Rice, maize, millets, *bajra*, pulses, arecanut, turmeric, and cassava are the main crops. The main thrust in the development of agriculture should be on crop improvement, water management, and fisheries. Brackish water prawn culture should be promoted in the coastal areas.

AGRO-ECOLOGICAL REGIONS OF INDIA

The concept of 'agro-ecological region' is a modification and improvement on agroclimatic regions. The concept of agro-ecological region is perhaps hazy to our scientific communities. People generally confuse these two terms (agroclimatic and agro-ecological) and use them in more or less the same way. But there is a distinct difference between these two terms. According to FAO (1983), agro-climatic region is a land unit in terms of major bioclimate and length of growing period and which is climatically suitable for certain range of crop cultivation. But agro-ecological region is the land unit carved out of agro-climatic region when superimposed on land form and soil condition that acts as modifier of the length of growing period. Therefore, within an agro-climatic region there may be a few agro-ecological regions depending on soil condition. This approach has been used in delineating agro-ecological regions of India.

Methodology

The methodology used in the delineation of agro-ecological region is shown in **Fig. 10.10** In order to prepare an agro-ecological region map, the soil-scap (soil-map) was superimposed on bio-climatic map. On the resultant map, the growing period was incorporated, using GIS technology.

In the demarcation of agro-ecological regions of India, the agro-climatic regions of India have been sub-divided on the basis of soil type. In the meso-regions thus obtained, the length of growing period (LGP) has been superimposed. This method has resulted into 20 agro-ecological regions and 60 agro-ecological sub-regions. The 20 agro-ecological regions of India have been plotted in **Fig. 10.10.**

The agro-ecological regions of India are:

1. Western Himalayas, cold arid eco-region with shallow soil and length of growing period less than 90 days.
2. Western Plain, Kachchh, and part of Kathiwara Peninsula, hot and arid ecoregion with desert and saline soils and growing period less than 90 days.